Remarks

In the office action mailed August 27, 2003, claims 40 – 93 and 98 – 106 were rejected under 35 U.S.C. §112, ¶1, claims 40 – 93 and 98 – 106 were rejected under 35 U.S.C. §112, ¶2, and claims 40 – 93 and 98 – 106 were rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,197,074 (to Emmons, Jr. et al.).

The claims were rejected under §112, ¶1 on the grounds that the specification, while being enabling for a variety of pulse shapes independent of the time interval between pulses, does not reasonably provide enablement for all pulse shapes and/or any time interval. The office action further states that the specification does not disclose a system with a time interval that is less than storage time needed for the pulse to build up or enable one to have a pulse shape that is approximately continuous.

Responsive to the office action, claims 40 - 44, 50 - 51, 54 - 59, 65 - 66, 69 - 76, 78, 86, 98 - 99, 101 - 104 were amended, claims 79 - 85 and 87 - 93 were cancelled, and new claims 112 - 128 were added. The language cited above with regard to §112, ¶1 has been removed from the claims.

In the background of the invention, the specification states that:

> at high repetition rates the time to store energy in the laser rod prior to each pulse is short and at low repetition rates the time to store energy in the laser rod prior to each pulse is long.

As a result of this well known effect, a difficulty arises in the use of lasers for trimming resistors. While a series of pulses may be provided at constant energy at a high repetition rate to trim material for a resistor, it is often desirable to slow the repetition rate when the amount of material to be removed becomes very small near the end of a removal process, particularly when

the value of the resistor is being measured between pulses. Unfortunately, if the repetition rate is slowed, the energy of the pulses at the slow repetition rate may be very high, defeating the purpose of slowing the repetition rate and possibly leading, for example to over-trimming or microcracking of the resistor material. Ideally it is desirable to be able to slow the repetition rate while maintaining a constant energy per pulse.

The invention provides dynamic pulse width control in accordance with an embodiment. For example, as disclosed in the specification and shown in Figure 3, during operation at slow repetition rates (e.g., 10KHz), the Q-switch 20 (as shown at 30 in Figure 3) remains open long after a laser pulse subsides and is closed (allowing energy from the pump to be delivered to the rod) just prior to the next pulse in an embodiment. In fact, the Q-switch 20 may be closed for the same amount of storage time that it was closed prior to each pulse while operating at a higher repetition rate (e.g., 40 KHz) as shown in Figure 3 in the illustrated embodiment. The resulting waveform is therefore the same irrespective of whether the repetition rate is 40 KHz or 10 KHz in the embodiment illustrated in Figure 3.

The claims were rejected under §112, ¶2 on the grounds that the claims are incomplete for omitting the essential step of keeping the unwanted portion of the pulse off or away from the target. In accordance with a further embodiment of the invention, an acousto-optic-modulator 26 may be used to deflect unwanted laser pulse energy (e.g., secondary pulses) away from the workpiece while the Q-switch 20 remains off, or to divert a portion of a primary pulse toward a workpiece. The use of a diverter unit such as an acousto-optic modulator, however, is not required by the invention. For example, if the Q-switch remains on for the same period of time prior to two different emission periods that correspond to two different repetition rates, then no diverter unit may be required in certain applications. The use of a diverter unit, therefore, is not

required by the present invention.

The claims were rejected under §103(a) on the grounds that Emmons, Jr. et al. discloses a method or operating a pulsed laser system in which storage or energy by the laser source is triggered for a fixed, predetermined period of time prior to each of a plurality of emission periods and that it would have been obvious to one or ordinary skill in the art to pre-select the output of the pulse shape and/or pulse energy of the pulsed laser system based on the known properties of the target material.

As discussed above, the invention provides that a plurality of repetition rates may be used without varying the shape or energy of each emission pulse. The Emmons, Jr. et al. reference does not disclose such as system. In particular, the method as claimed in amended independent claim 40, requires, in part, selecting a first time interval, pulsing for a *first* period of time, selecting a second time interval and then pulsing for the same *first* period of time. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these steps.

The method as claimed in amended independent claim 55 requires, in part, selecting a first time interval, selecting a *first* pulse shape, causing the laser source to process a target material at the first time interval and the *first* pulse shape, selecting a selecting time interval and causing the laser source to process the target material at the second time interval and the *first* pulse shape. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these steps.

The method as claimed in amended independent claim 86 requires, in part, selecting a first time interval, selecting a *first* pulse energy, pulsing the laser system at a constant first power, causing the laser source to process a target material at the first time interval and the *first* pulse energy, selecting a selecting time interval, again pulsing the laser system at the constant first

power, and causing the laser source to process the target material at the second time interval and the *first* pulse energy. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these steps.

The method as claimed in amended independent claim 98 requires, in part, pulsing for a first predetermined period of time prior to an emission period associated with a first time interval, causing the laser source to micro-machine a workpiece with pulses having a first time interval and a first energy characteristic, selecting a second time interval, pulsing for the first predetermined period of time prior to a second emission period associated with a second time interval, and causing the laser source to process a target material on a workpiece with pulses having a second time interval and the first energy characteristic. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these steps.

The system as claimed in new claim 112 requires, in part, selection means for permitting selection of a second time interval at which emission energy will be directed toward a trimmable component, said second time interval being different than the first time interval; and adjustment means for providing that emission energy is directed toward the trimmable component at the second time interval at the first pulse energy. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these elements.

The system as claimed in new claim 120 requires, in part, selection means for permitting a second time interval to be selected at which emission energy will be directed toward a trimmable component, said second time interval being different that the first time interval; and adjustment means for providing that the first period of time that the switch is in the first position remains the same during operation at the second time interval. The Emmons, Jr. et al. reference does not disclose, teach or in any way suggest these elements.

Each of independent claims 40, 55, 86, 98, 112 and 120 is therefore submitted to be in condition for allowance. Each of dependent claims 41 - 54 depends either directly or indirectly from claim 40 and is also submitted to be in condition for allowance. Each of dependent claims 56 - 78 depends either directly or indirectly from claim 55 and is also submitted to be in condition for allowance. Each of claims 99 - 106 depends either directly or indirectly from claim 98 and is also submitted to be in condition for allowance. Each of new claims 113 - 119 depends either directly or indirectly from new claim 112, and each of new claims 121 - 127 depends either directly or indirectly from new claim 120. New claims 113 - 119 and 121 - 128 are submitted to be in condition for allowance.

Claims 40 - 78, 86, 98 - 106 and 112 - 128 are submitted to be in condition for allowance. Favorable action consistent with the above is respectfully requested.

Respectfully submitted,

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